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(第二版)

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汽车实用英语

(第二版)

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Unit 1

Automotive Maintenance

Overall Objectives

Upon completion of this unit, you should be able to:

- ▶ learn key terms about automotive maintenance in this unit;
- ▶ understand the basic procedures of automotive maintenance;
- ▶ use maintenance manual to deal with the practical problems.

Tasks Introduction

Task 1.1 Engine Oil and Oil Filter Change

Task 1.2 Checking Drive Belt

Task 1.3 Checking Cooling System

Task 1.4 Replacing Spark Plugs

Task Description

Automotive maintenance describes the act of inspecting or testing the condition of car subsystems and servicing or replacing parts and fluids. Regular maintenance is critical to ensure the safety, reliability, drivability, comfort and longevity of an automotive. The following tasks (e.g. oil and filter change, checking drive belt, replacing spark plugs, etc.) are the important items in auto maintenance to avoid major damage or for safety reasons.

Task 1.1 Engine Oil and Oil Filter Change



Learning Objectives

After completing this task, you should be able to:

- ▶ identify auto parts by English names in this task;
- ▶ understand the steps of changing oil and oil filter in the English maintenance manual;
- ▶ learn to describe the process of changing oil and oil filter.



Learning Preparation

Key terms—maintenance; oil; oil filter; oil pan; jack up; remove; undo; drain plug; sealing ring; tightening torque

Relative specialized knowledge; Multimedia; Internet; Automotive English-Chinese dictionary; Automotive maintenance manual



Plan and Implement

Step 1 A maintenance case is provided;

Step 2 Learn the process of changing oil and oil filter via a maintenance manual;

Step 3 Require students to grasp the key terms in this task;

Step 4 Try to describe the process of oil and oil filter change;

Step 5 Students read relative material;

Step 6 Assessment.



Assessment and Feedback

True or False

- () 1. Engine oil should be drawn from the oil pan.
- () 2. The vehicle can be jacked up at any point.
- () 3. The oil drain plugs should be cleaned before it is installed to the vehicle.
- () 4. The oil filter should be unscrewed by a special tool.
- () 5. The oil filter housing should be removed horizontally downwards.
- () 6. The oil filter housing must be protected carefully during O-ring being levered off.
- () 7. The oil filter housing should be tightened to 19 Nm.
- () 8. The O-ring can be reused.

- () 9. The car must be jacked up before you change the oil.
- () 10. The waste oil can be disposed as you like.

Relative Knowledge

Lubrication System

The engine lubrication system serves two purposes: it reduces metal-to-metal friction and wear between rotating and sliding parts, and it carries excess heat away from the engine. Among the important surfaces requiring lubrication are the crankshaft journal bearings, connecting rod bearings, piston pins, cylinder walls, piston skirts and rings, camshaft bearings and valve mechanism.

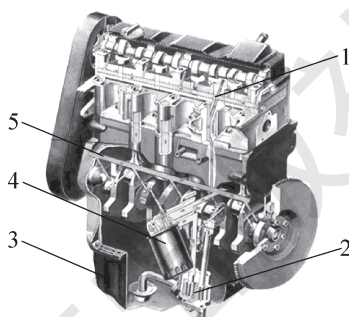


Fig. 1.1.1 Lubrication System

1—oil gallery; 2—oil pump; 3—oil pan; 4—oil filter; 5—main oil gallery

An oil supply of 4 to 5 quarts (or liters), depending on engine size and design, is maintained in the crankcase. A screened, floating oil intake is provided by a lubricating-oil pump. Located in the deepest part of the crankcase, the intake rises and falls with the oil level. Oil is picked up by the circulating pump and delivered at a pressure of approximately 40 pounds per square inch (3 kg/cm^2) to a main gallery that runs the length of the cylinder block. Branch passages then conduct the oil to the valve mechanism, camshaft bearings, and crankshaft main bearings. From the main-bearing journals it flows through the drilled crankshaft to the connecting-rod bearings, passing up through drilled holes in the I-beam connecting rods to the wrist-pins and piston bosses to which they are attached. Cylinder walls and piston skirts are lubricated by oil thrown from rotating parts; excess oil is scraped from the cylinder walls by the oil-control rings and drained back down into the crankcase.

A gauge or signal light on the instrument panel indicates the state of the oil pressure. The oil level in the crankcase is measured either by a graduated “stick” type of gauge or by a direct-reading gauge on the instrument panel.

Practice—Maintenance Manual Reading

Engine Oil and Oil Filter Change

 Note!

• Engine oil should not be extracted, as particles of dirt may remain in the oil pan.

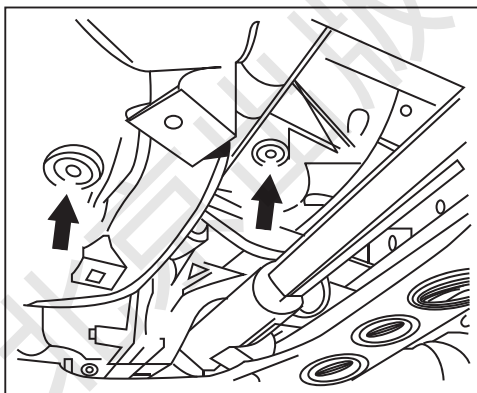
(1) Jack up the vehicle at the points provided.

(2) Remove underside panel.

 Warning!

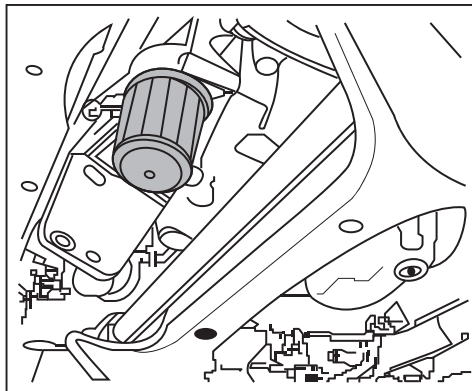
• Danger of scalding from draining oil! Wear protective equipment specified.

(3) Undo the 2 oil drain plugs and collect engine oil in a disposal container. Dispose of waste oil in accordance with legal requirements.



(4) Clean oil drain plugs and screw in with new aluminum sealing ring. Tightening torque 50 Nm (37 ftlb.).

(5) Undo oil filter with special tool (release key) 9204 and unscrew it.



Oil and Oil Filter
Change

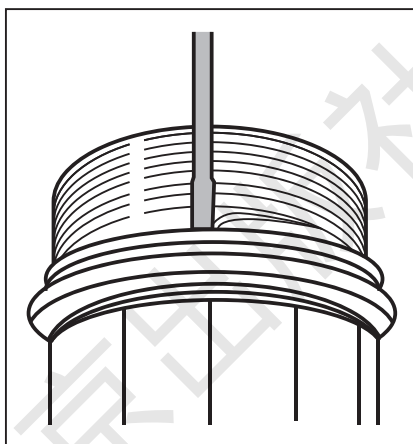
(6) Remove oil filter housing vertically downwards. Drain remaining oil into a disposal container.

(7) Remove filter element. Remove the filter downwards and dispose of it in accordance with legal requirements.

i Note!

- Do not remove O-ring with a sharp object.
- The oil filter housing contains a cutout with which the O-ring can be removed.

(8) Clean oil filter housing -1- and replace O-ring seal. Clean oil filter housing thoroughly inside and outside and replace the O-ring. Carefully lever off the O-ring. The oil filter housing must not be damaged during this procedure.



(9) Install filter element.

i Note!

- Lightly oil O-ring when installing oil filter housing.

(10) Install oil filter housing and tighten to 25 Nm (19 ftlb.). Using special tool (release key) 9204. Lightly oil the O-ring when doing this. Tightening torque 25 Nm (19 ftlb.).

(11) Fill with engine oil. The oil change quantity is 8.75 litres after a dripping time of approx. 20 minutes.

(12) Fit the underside panel.

Tightening Torques

Location	Thread	Tightening Torque [Nm] (ftlb.)
Oil drain plugs	M18×1.5	50 (37)
Oil filter housing		25 (19)

Task 1.2 Checking Drive Belt



Learning Objectives

After completing this task, you should be able to:

- ▶ identify auto parts by English names in this task;
- ▶ understand the steps of checking drive belt in the English maintenance manual;
- ▶ learn to describe the process of checking drive belt.



Learning Preparation

Key terms—drive belt; check; spark plug; intake fitting; fasten; throttle body; pressure; hot film mass air flow sensor; locking clip; tensioning roller

Relative specialized knowledge; Multimedia; Internet; Automotive English-Chinese dictionary; Automotive maintenance manual



Plan and Implement

Step 1 A maintenance case is provided;

Step 2 Learn the process of checking drive belt via a maintenance manual;

Step 3 Require students to grasp the key terms in this task;

Step 4 Try to describe the process of checking drive belt;

Step 5 Students read relative material;

Step 6 Assessment.



Assessment and Feedback

True or False

- () 1. When you change the spark plugs you should check the drive belt also.
- () 2. The drive belt can be removed whether it is hot or not.
- () 3. When the drive belt is removed when hot, it will be deformed.
- () 4. The throttle body cover should be pulled off at any direction.
- () 5. The pressure pipe is above the Y pipe.
- () 6. A drive belt is usually used to drive the accessories on the engine.
- () 7. Remain a mark on the side of the drive belt when you check it.
- () 8. When cranking the engine, the deflection rollers should also be checked for

damage.

- () 9. If there is slight tear in a rib, the drive belt must be replaced.
- () 10. When the crack is running to base of rib, the drive belt must be replaced.

Relative Knowledge

Drive Belt

A drive belt is used to drive accessories installed on your car engine, such as an alternator, water pump, power steering pump and air conditioner compressor. Sometimes a drive belt could also be called a “serpentine belt” or “accessories belt”. Some cars have a single drive belt running all the accessories and others may have two or more drive belts. Older cars usually used V-shaped belts, while today’s cars use V-ribbed belts that are flat on one side and have ribs on the other side (shown in the following Fig. 1.2.1).

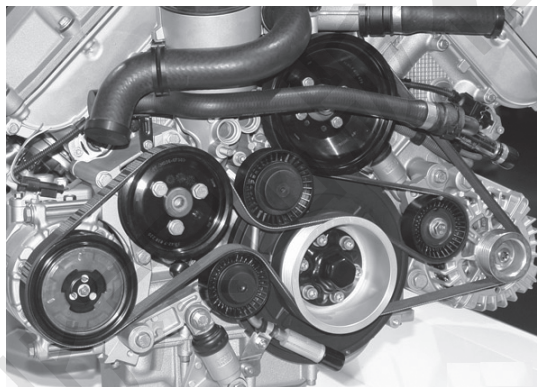


Fig. 1.2.1 V-ribbed Drive Belt

Drive Belt Tensioner

Over time, the drive belt stretches. To compensate for this there is a belt tensioner that keeps the drive belt under proper tension. In some older cars, a belt tensioner had to be manually adjusted from time to time. If not adjusted in time, the belt would get loose and start slipping, making a loud whistling or squeaking noise. Commonly you would hear this noise when the car is just started cold in the morning or when turning the steering wheel all the way left or right to the limit. Most of the newer cars have a drive belt with a spring-loaded self-adjusting tensioner that maintains the proper belt tension automatically.

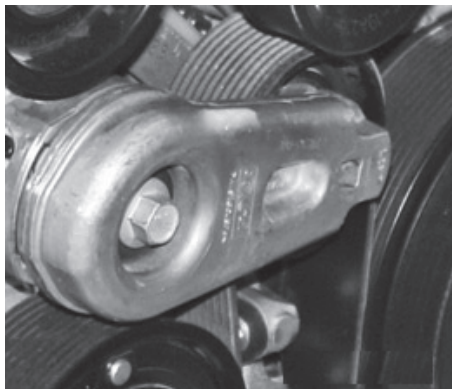


Fig. 1.2.2 Self-adjusting Drive Belt Tensioner

Drive Belt Problems

A drive belt is made from very flexible and durable material, but it still wears over time. On average, a drive belt can last 3~4 years. Improper tension, excessive heat, engine oil leaking onto the belt and the pieces of debris stuck between the belt ribs can cause the belt to wear faster. A worn out belt may cause squeaking or whistling noise and a badly worn out belt can break. (You can see cracks and missing chunks in the following Fig.1.2.3)



Fig. 1.2.3 Badly Worn Drive Belt

Practice—Maintenance Manual Reading

Checking Drive Belt



Note!

• If spark plugs must be changed during the course of maintenance operations, the drive belt should be checked when the spark plugs are removed. The engine can then be cranked easier.



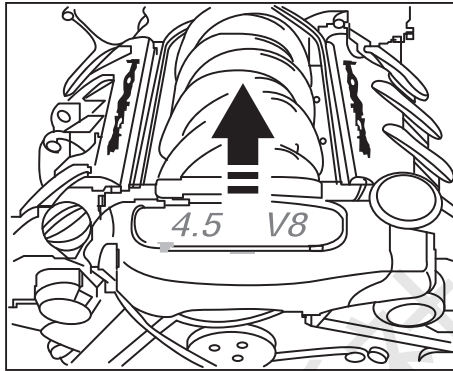
Checking Drive Belt

Warning!

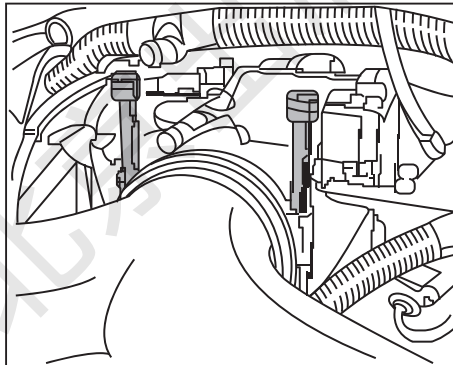
Risk of damage:

- Never remove drive belt when it is hot.
- If the drive belt is removed when it is hot, it can be pulled out of shape and damaged.

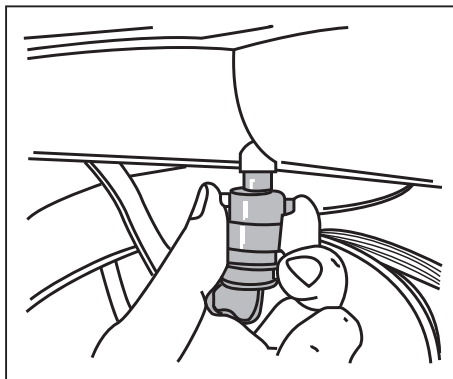
(1) Remove throttle body cover. Pull off cover vertically upwards.



(2) Remove Y intake fitting. To do this, pull the left and right fastening pins on the throttle body vertically upwards.

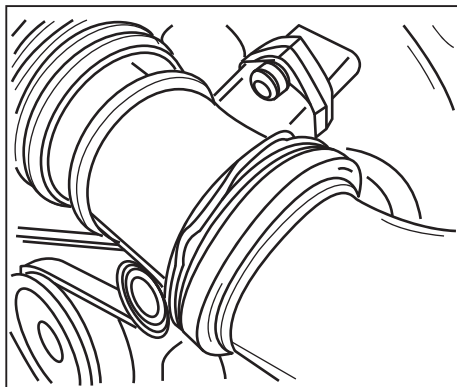


(3) Disconnect pressure pipe on the underside of the Y pipe.

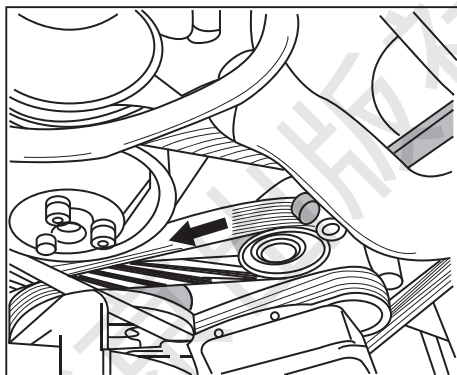


(4) Undo the Y intake fitting left and right on the hot film mass air flow sensor. To do

this, pull the locking clips vertically upwards.



- (5) Disconnect the hot film mass air flow sensor and remove the Y pipe from the vehicle.
- (6) Using chalk, mark the drive belt in the area around the tensioning roller.

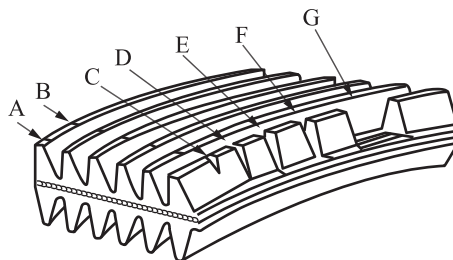


- (7) Twist engine on vibration damper using a socket wrench (a/f 19) until the chalk mark is at the same place again. While turning, check the deflection rollers of the drive belt on the crankshaft for damage.

Damage Symptoms

Note!

- The drive belt must be replaced if any of the following damage occurs:



Item	Type of Damage	Remarks
-A-	Slight tear in a rib	Drive belt is OK
-B-	Hair crack that runs across the entire belt width or butt seam is damaged	Replace drive belt
-C-	Crack running up to half of rib height	Drive belt must be replaced if there is more than one crack running up to half of rib height
-D-	Crack running to base of rib	Replace drive belt
-E-	Crack running to cord or sides so worn that the traction cord is no longer visible	Replace drive belt
-F-	Rib detachment	Replace drive belt
-G-	Rib fracture	Replace drive belt

Task 1.3 Checking Cooling System



Learning Objectives

After completing this task, you should be able to:

- ▶ identify auto parts by English names in this task;
- ▶ understand the steps of checking cooling system in the English maintenance manual;
- ▶ learn to describe the process of checking cooling system.



Learning Preparation

Key terms—cooling system; check; level; antifreeze; coolant; top up; leakage; pressure; expansion tank

Relative specialized knowledge; Multimedia; Internet; Automotive English-Chinese dictionary; Automotive maintenance manual



Plan and Implement

Step 1 A maintenance case is provided;

Step 2 Learn the process of checking cooling system via a maintenance manual;

Step 3 Require students to grasp the key terms in this task;

Step 4 Try to describe the process of checking cooling system;

Step 5 Students read relative material;

Step 6 Assessment.



Assessment and Feedback

True or False

- () 1. The engine coolant must be changed every 2 years.
- () 2. When replacing or topping up the coolant, Porsche original antifreeze or other types of antifreeze are both OK.
- () 3. The cooling system must be opened when the coolant is hot.
- () 4. You should wear gloves to prevent from being scalded.
- () 5. That screwing on the lid in an anti-clockwise direction is to undo it.
- () 6. A test pressure of about 2.5 bar should be applied to the hose.
- () 7. The test pressure applied to check leakage of cooling system must be maintain a constant pressure.
- () 8. The coolant level should be between the “min” and “max”.
- () 9. When the cover of the expansion tank is locked, you can hear a click.
- () 10. The radiator can be cleaned by a vacuum cleaner.

Relative Knowledge

Cooling System

Although gasoline engines have improved a lot, they are still not very efficient at converting chemical energy into mechanical power. Most of the energy in the gasoline (perhaps 70%) is converted into heat, and it is the job of the cooling system to take care of that heat. As fuel is burned in the engine, about one-third of the heat energy in the fuel is converted into power. Another third goes out through the exhaust pipe unused, and the remaining third must be handled by the cooling system. The purpose of the cooling system is to keep the engine at its most efficient operating temperature at all speeds under all driving conditions.

Although the primary job of the cooling system is to keep the engine from overheating by transferring this heat to the air, it also has several other important jobs. When the engine is cold, components wear out faster, and the engine is less efficient and emits more pollution. So another important job of the cooling system is to allow the engine to heat up as quickly as possible, and then to keep the engine at a constant temperature.

There are two typical types of cooling system: water-cooling system and air-cooling system. Water-cooling system is more common. The cooling medium, or coolant, in them is either water or some low-freezing liquid, called antifreeze. A water-cooling system consists of the engine water jacket, thermostat, water pump, radiator, radiator cap, fan, fan drive belt and necessary hoses.

Fig. 1.3.1 shows the components of a water-cooling system. As the vehicle is started, the water pump begins circulating the coolant. The coolant goes through the cylinder block from the front to the rear, and circulates around the cylinders. The coolant then passes up into the cylinder head through the holes in the head gasket, and moves forward to cool the spark plug and exhaust valve areas through internal passages.

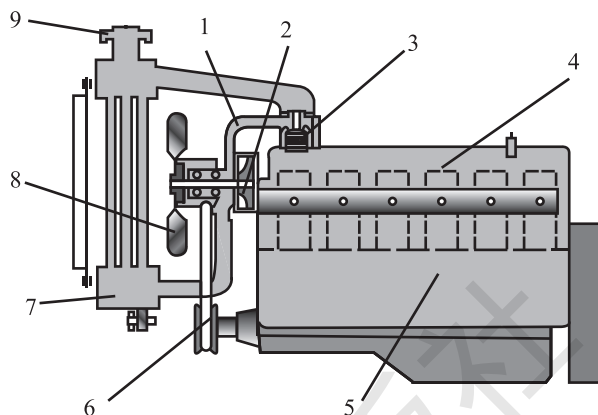


Fig. 1.3.1 Cooling System

1-bypass; 2-water pump; 3- thermostat; 4-cylinder head; 5-cylinder block;
6-fan belt; 7-radiator; 8-fan; 9-radiator pressure cap

After leaving the cylinder head, the coolant passes through a thermostat on the way to the radiator. As long as the coolant temperature remains low, the thermostat stays closed. Under this condition the coolant flows through the bypass tube and returns to the pump for recirculation. As the coolant heats up, the thermostat gradually opens to allow enough hot coolant to pass through the radiator, and maintain the engine operating at highest temperature. From the thermostat, the coolant flows to the internal passages in the radiator and is being cooled by the air passing through the radiator. Then the coolant backs to the pump.

Practice—Maintenance Manual Reading

Checking Cooling System

Coolant: checking the level and antifreeze protection content



Note!

• The engine cooling system is factory-filled with a coolant that does not need to be changed. The coolant should not be mixed with

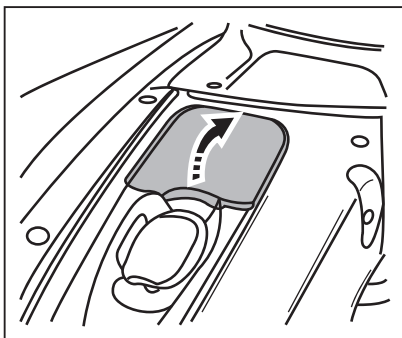


Checking Cooling
System

other coolants.

- Only original Porsche antifreeze protection should be used when replacing or topping up the coolant.

(1) Open maintenance cover.

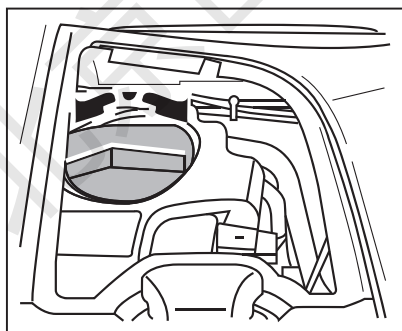


Warning!

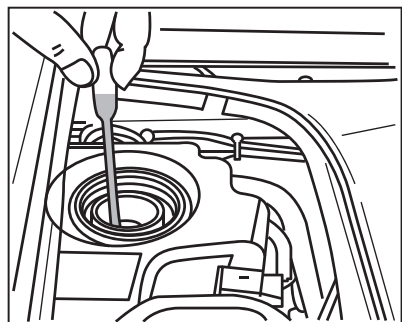
Danger of scalding!

- Coolants can be extremely hot and pressurised.
- Only open cooling system when it is cold.
- Wear gloves.

(2) Carefully open lid on expansion tank. Screw on lid in an anti-clockwise direction.



(3) Check antifreeze protection content. If it is lower than -37°C , it should be corrected accordingly. The coolant level must not drop below the minimum mark.



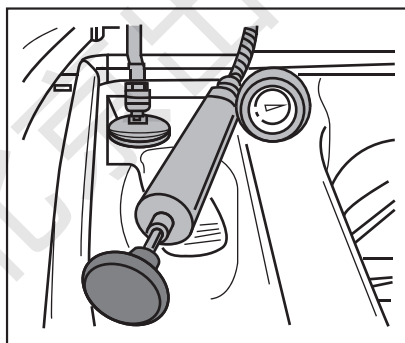
Note!

• The following table specifies how much coolant must be replaced by pure antifreeze protection in order to adjust the freezing point to -37°C .

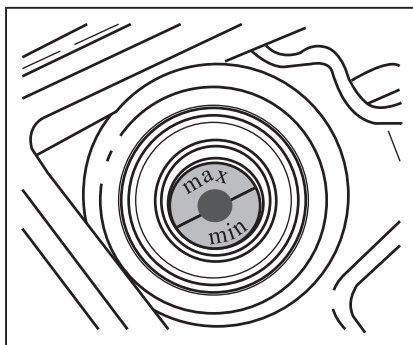
Measured Antifreeze Protection (in $^{\circ}\text{C}$)	Antifreeze Protection Quantity to be Added (in litres)
-5	9
-10	8.5
-15	7.5
-20	7
-25	5
-30	3.5
-35	1.5

Checking the Cooling System for Leaks

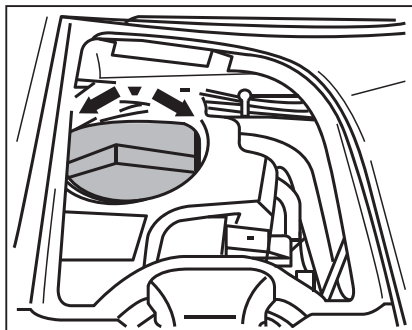
(1) Check the cooling system for leaks. To do this, apply a test pressure of approx. 1.5 bar using the cooling system test device and check hose connections for leakage. The pressure must not drop.



(2) Check the engine coolant level. A graduated washer with a *min* and a *max* marking is located in the lock opening in the expansion tank. The “min” level must be covered with coolant.



- (3) Screw on the cover of the expansion tank again until it locks with an audible click.



- (4) Close the maintenance cover.

(5) Check radiators for external dirt. The radiators should not contain too much dirt. If necessary, they can be cleaned using a vacuum cleaner with a brush attachment.

Task 1.4 Replacing Spark Plugs



Learning Objectives

After completing this task, you should be able to:

- ▶ identify auto parts by English names in this task;
- ▶ understand the steps of replacing spark plugs in the English maintenance manual;
- ▶ learn to describe the process of replacing spark plugs.



Learning Preparation

Key terms—spark plug; torque arm; unscrew; pump; ignition coil; hose; wiring harness, special tool; electrode gap; engage

Relative specialized knowledge; Multimedia; Internet; Automotive English-Chinese dictionary; Automotive maintenance manual



Plan and Implement

- Step 1 A maintenance case is provided;
- Step 2 Learn the process of replacing spark plugs via a maintenance manual;
- Step 3 Require students to grasp the key terms in this task;
- Step 4 Try to describe the process of replacing spark plugs;

Step 5 Students read relative material;

Step 6 Assessment.



Assessment and Feedback

True or False

- () 1. Before replacing the spark plugs, the ignition switch must be off.
- () 2. There are six fastening screws on the ignition coil cover.
- () 3. In order to avoid breaking the design cover, a cloth should be placed between the cover and the secondary air pump.
- () 4. The ignition coils are connected with wiring harness.
- () 5. The spark plug should be removed by a special tool (spark plug wrench).
- () 6. A new spark plug can be installed without checking.
- () 7. The electrode gap for the spark plug must be 1.9 mm.
- () 8. The new spark plugs should be tightened to 25 Nm.
- () 9. The ignition coil should be engaged with a click.
- () 10. The 2 rubber mounts must be pressed in the bracket.

Relative Knowledge

Spark Plug

A spark plug is a device for delivering electric current from an ignition system to the combustion chamber to ignite the compressed air-fuel mixture by an electric spark.

It forces electricity to arc across a gap, just like a bolt of lightning. The electricity must be at a very high voltage in order to travel across the gap and create a good spark. Voltage at the spark plug can be anywhere from 40,000 to 100,000 volts.



Fig. 1.4.1 Spark Plug

The spark plug must have an insulated passageway for this high voltage to travel down to the electrode, where it can jump the gap and, from there, be conducted into the engine block and grounded. The plug also has to withstand the extreme heat and pressure inside the cylinder, and must be designed so that deposits from fuel additives do not build up on the plug.

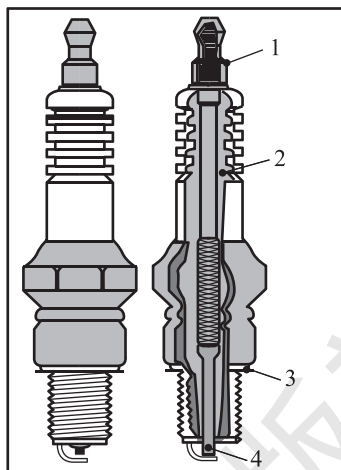


Fig. 1.4.2 Spark Plug Cutaway

1—connector (to plug wire); 2—ceramic insulator; 3—gasket; 4—electrode

Spark plugs use a ceramic insert to isolate the high voltage at the electrode, ensuring that the spark happens at the tip of the electrode and not anywhere else on the plug; this insert does double-duty by helping to burn off deposits. Ceramic is a fairly poor heat conductor, so the material gets quite hot during operation. This heat helps to burn off deposits from the electrode.

Some automobiles require a hot plug. This type of plug is designed with a ceramic insert that has a smaller contact area with the metal part of the plug. This reduces the heat transfer from the ceramic, making it run hotter and thus burn away more deposits. Cold plugs are designed with more contact area, so they run cooler.

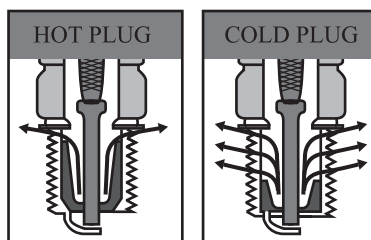


Fig. 1.4.3 Hot Plug and Cold Plug

The manufacturer will select the right temperature plug for each car. Some cars with high-performance engines naturally generate more heat, so they need colder plugs. If the spark plug gets too hot, it could ignite the fuel before the spark fires; so it is important to stick with the right type of plug for your car.

Practice—Maintenance Manual Reading

Replacing Spark Plugs

Note!

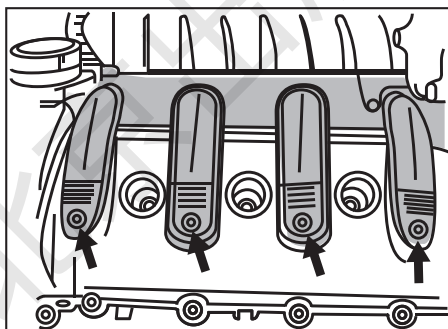
- Ignition is off, ignition key is removed.

Removing design cover of cylinder bank 5 - 8

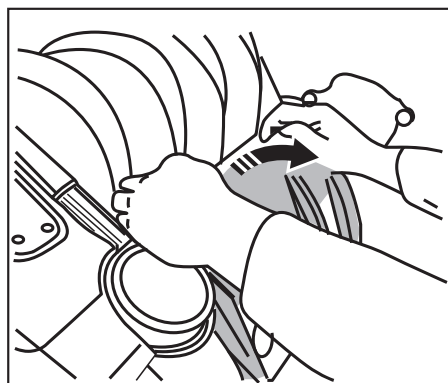
Note!

- Place a cloth between secondary air pump and design cover to avoid scratching cover.

(1) Unscrew the 4 fastening screws on the ignition coil cover.

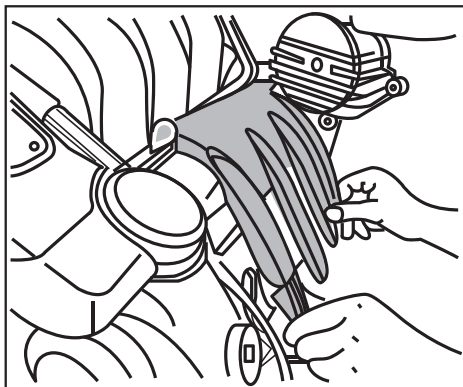


(2) Remove design cover of cylinder bank 5 - 8. Using 2 hands, lift the cover slightly at the edge facing the intake system until it snaps out of its holder.



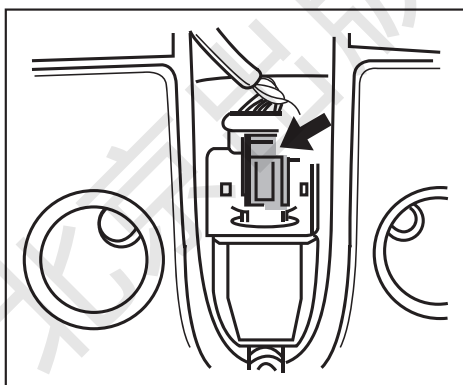
Spark Plug

Lift design cover at the front and pull it out.

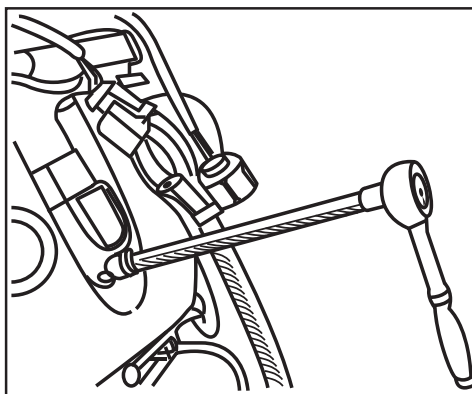


Replacing Spark Plugs

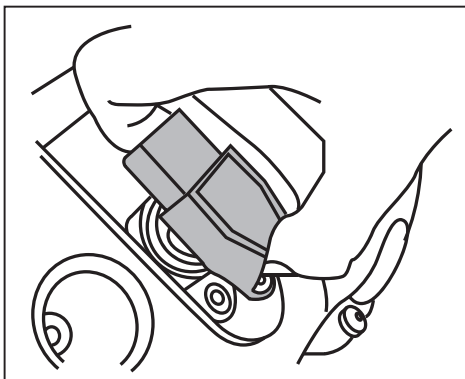
- (1) Pull off the lower hose on secondary air pump 5 - 8.
- (2) Disconnect the 8 ignition coils from wiring harness. To do this, press on the button and, at the same time, pull off the plug.



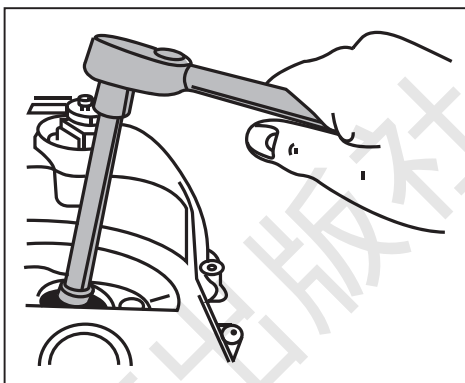
- (3) Undo active ignition coil. To do this, undo the fastening screw on the valve cover.



- (4) Pull out ignition coil and lay to one side.



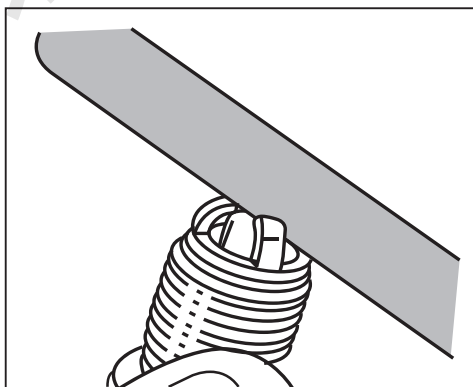
(5) Undo spark plug using special tool (spark plug wrench) 3122B .



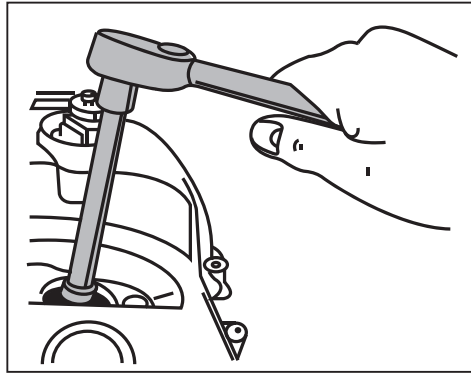
i Note!

- Permissible spark plugs: Bosch FGR 6 KQE.
- Check electrode gap before screwing in a new spark plug.

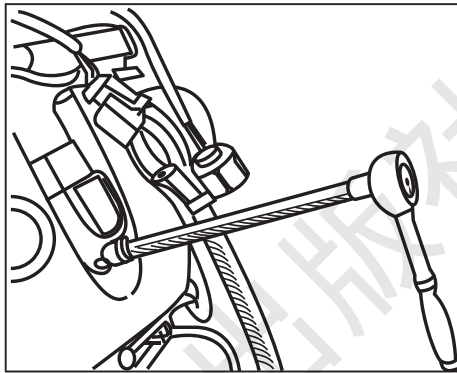
(6) Check electrode gap. The electrode gap for the spark plug must be 1.6 mm.



(7) Tighten spark plug using special tool (spark plug wrench) 3122B. Spark plugs that are already fitted are tightened to 25 Nm (19 ftlb.), new spark plugs are tightened to 30 Nm (22 ftlb.) when first tightened.



(8) Push on active ignition coil again. Tighten the fastening screws to 10 Nm (7.5 ftlb.).



(9) Reconnect ignition coil. The plugs must engage audibly.

(10) Push on the lower hose on secondary pump 5 - 8.

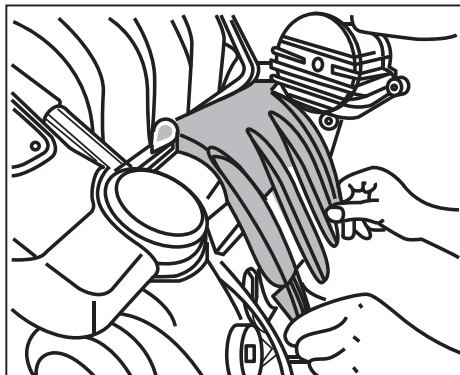
Installing design cover for cylinder bank 5 - 8



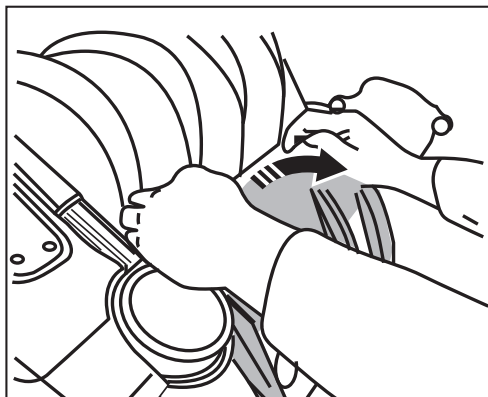
Note!

• Place a cloth between secondary air pump and design cover to avoid scratching cover.

(1) As shown in the Figure, push design cover under secondary air pump.



(2) Then press in the 2 rubber mounts on the holder. The rubber mounts must engage perceptibly.



(3) Tighten the 4 fastening screws on the ignition coils to 4 ~ 5 Nm (3 ~ 3.5 ftlb.).

Tightening Torques

Location	Thread	Tightening Torque [Nm] (ftlb.)
Spark plugs	M14×1.25	30 (22)
Initial tightening		25 (19)
Refitting		
Ignition coil	M6	10 (7.5)
Fastening screws of design cover	M5	5 (3.5)
Bracket for torque arm	M8×45	23 (17)
	M6×40	5 (3.5), then 10 (7.5)
Torque arm on bracket	M10×70	60 (44)
Torque arm on body	M10×20	60 (44)
Secondary air pump	M6×50	10 (7.5)